T

Utilization of Rutherford High Energy Laboratory when 300 GeV Accelerator is Working

I.M. Blair and I. Butterworth

When the 300 GeV machine is brought into operation it will be the predominant source of high energy physics in Europe. As envisaged in the ECFA Reports efficient use of that machine would only result if it were backed by viable national programmes. The arguments are well known: that it is inconceivable that a significant fraction of the European high energy physics community could, at any given time, be resident at the 300 GeV Laboratory; that tight scheduling would prevent long-shot experiments, instrumental innovations that require beam time etc; that the need for efficiency would discourage the employment of inexperienced graduate students and so inhibit their training. The validity of such arguments is demonstrated by the success shown by the Nimrod programme in relationship to that at the CERN P.S. A survey of future plans of Nimrod users reveals a list of some 40 possible and worthwhile experiments. Assuming a rate of about 4 experiments per year, and that the number of other experiments thought of balances the number of experiments out of the original 40 that never get done, one predicts a date of around 1980 for the end of Nimrod's useful life in its present form. This corresponds quite well, within experimental uncertainty, with the date at which the 300 GeV machine would come into operation for physics. Thus when the 300 GeV machine is in operation one can probably safely assume that Nimrod will be incapable of carrying out competitive physics, and a machine bearing the same relationship to the 300 GeV accelerator that Nimrod bears to the P.S. would be needed. The same E* ratio and in some measure a similar secondary flux ratio would be maintained by a machine of 20 - 30 GeV. The suggestion that one replaces the present Nimrod ring with super conducting magnets would meet these criteria, and also provide a challenge in advanced technology, which might be relevant to the design of accelerators in the 1,000 GeV range.

In the present climate, one must face the possibility that it will not be possible to replace or modify NIMROD to this specification and that there would be no British machine other than possibly an upgraded NINA electron accelerator. Such an electron machine would be better than nothing. However, the limited number of experiments that could be satisfactorily mounted, the different nature of the physics carried out from that at the 300 GeV Laboratory, and the suspicion that there are fewer questions to answer in the realm of electromagnetic interactions than in those of strong and weak interactions, all make it less attractive than a 25 GeV proton machine. It would not solve the problems of 300 GeV orientated physicists.

For them, it approximates to the no British machine situation.

If one assumes that there is no British accelerator, how could effective use be made of the 300 GeV machine? What will be the role of the Rutherford Laboratory? The answers to these two questions are obviously related, but it is essential that R.H.E.L. must be more than a mere "staging post" for the 300 GeV machine. The phrase strikes horror in the hearts of Laboratory staff, and suspicion in university users; it is unfortunate that it was ever coined. Certainly this will be one of the functions of the new, post-Nimrod, Rutherford Laboratory, but in order to survive as a viable centre the Laboratory must take on the character and aura of an Institute for Advanced Studies.

For the counter physicist, spending, say, one year in five at the 300 GeV machine, what would attract him to the Rutherford Laboratory to base his research effort here rather than at his university during his four "off" years? What will he be doing during those four years? As he can do only one high energy experiment every five years he will have more opportunity to analyse his results in depth to extract the maximum amount of physics from them. This would be a significant improvement over present practice, when results are often hurriedly and scantily analysed because one's effort is required for the next experiment. If he felt that at the Rutherford Laboratory he had access to the best computing facilities in the country, and had the greatest probability of meeting and discussing his results with other physicists, then he would naturally gravitate here. Thus the Rutherford Laboratory should ensure that it has the best computing facilities, a strong Theory group, and strong "in-house" research groups over the full range of high energy physics.

The problems of the inability of academic staff to spend much of the time abroad and the problems of graduate student training and supervision have been successfully bypassed in bubble chamber physics because of the off-line nature of the analysis.

A natural course of development from centrally operated chambers is centrally measured film. When fast pulsing chambers with low beam density permit automatic scanning and measurement there seems little reason why the user should not be provided with data on complete events, rather than with film. The generality of the technique means that there is usually not a great 'physics' content to the measuring activity.

In terms of direct support of the 300 GeV programme, the Rutherford Laboratory should offer the following:-

(1) An Information Centre, providing up-to-date details on Beam-lines, "who's who" at 300GeV, plans of other European groups, meeting dates of appropriate committees, etc., etc.

(2) A team of experienced design engineers to work in close support with the research physicists during the planning stages of an experiment.

(3) Facilities for developing new techniques for specific experiments.

(4) To co-ordinate the construction and assembly of apparatus.

(5) To design and construct large pieces of equipment such as bubble chambers and spark chamber assemblies; doing this nationally rather than at the 300 GeV centre would permit closer technical and budgetary control and would benefit local industry.

(6) A T.V. link with the 300 GeV Laboratory to enable British physicists to participate in seminars and other discussions with colleagues at that Laboratory.

Such a supporting role for a National Laboratory would only be efficient if it were not duplicated at the 300 GeV centre. However, other European countries have such national laboratories, e.g. DESY, Saclay, Frascatti etc. and this mode of operation could well become widely accepted.

In conclusion, it would appear that the Rutherford Laboratory has a future in the 300 GeV era, the absence of a local accelerator being detrimental but not fatally so. We stress, however, that the Laboratory must maintain a life of its own and not become just an engineering support facility for the 300 GeV programme. It must become the British Institute for Advanced Studies in High Energy Physics.